



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b> <b>C07G 017/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 91/01989</b> <b>(43) International Publication Date:</b> 21 February 1991 (21.02.91)
<b>(21) International Application Number:</b> PCT/AU90/00335 <b>(22) International Filing Date:</b> 7 August 1990 (07.08.90) <b>(30) Priority data:</b> PJ 5648 8 August 1989 (08.08.89) AU <b>(71) Applicant (for all designated States except US):</b> CHEM ENG CONTRACTS PTY LIMITED [AU/AU]; 8 Simpson Street, Moorabbin, VIC 3189 (AU). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> CONNOLLY, David, Leonard [AU/AU]; 3 Dale Street, Balwyn, VIC 3103 (AU). <b>(74) Agent:</b> OBERIN, Colin, James; Oberins Patent Attorneys, 66 Croydon Road, Croydon, VIC 3136 (AU).		<b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent)*, DK (European patent), ES (European patent), FR (European patent), GB (European patent), IT (European patent), LU (European patent), NL (European patent), NO, SE (European patent), US.  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> TANNIN EXTRACTION  <b>(57) Abstract</b>  Method for extracting tannins from bark and multi-stage apparatus suitable therefor. The method includes the steps of: contacting bark containing tannins with a first tannin enriched aqueous wash medium at elevated temperatures; separating the tannin-rich liquid extract by filtration including dewatering the resulting filter cake under pressure; washing the filter cake with a plurality of aqueous wash media at elevated temperatures; and separating the tannin enriched media after each washing stage by filtration including dewatering the filter cake under pressure; wherein each successive wash medium has a lower degree of tannin enrichment than the preceding wash medium.		

### DESIGNATIONS OF "DE"

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## TITLE: TANNIN EXTRACTION

BACKGROUND OF THE INVENTION

## 1. Field of the Invention

The present invention relates to the extraction of tannins from natural sources and in particular to the extraction of tannins present in bark and wood extracts.

Tannins may be found in the bark and wood extracts of various varieties including wattles (acacias) and pines (pinus). Such naturally occurring tannins are polyhydroxyphenols commonly referred to as polyphenols. In pinus radiata bark for example the molecular weight of tannins can range from less than  $10^3$  to more than  $10^6$ .

Wattle tannins are generally of lower molecular weight and lower viscosity which is generally believed to be due to the action of sugars naturally present in wattle tannins acting as viscosity reducers.

Pine tannins are generally more reactive than wattle tannins and are especially suitable for use as wood adhesives, particularly in the manufacture of plywood and particle board. Other potential applications for tannins include finger jointing wood adhesives, paper impregnation, leather tanning, dispersing clays, minerals and pigments, foundry core binding and polyurethane production.

The higher molecular weight and higher viscosity portions of tannins are useful in production of adhesives but are difficult to extract with conventional methods as they do not diffuse as readily as tannins of lower molecular weight.

## 2. Discussion of the Prior Art

Australian Patent Specification 533,791 discloses a method for producing a low viscosity material suitable for use in a formaldehyde-condensation adhesive which comprises subjecting a conventional aqueous extract of bark or wood to ultrafiltration and separating out that fraction which does not contain the high viscosity producing materials. There is no detailed disclosure of the method or apparatus of extraction only a reference to simple batch extraction of comminuted wood and bark with hot water at about 100°C. This

conventional technique has the disadvantage however of low extraction rates.

10 Australian Patent Specification 569,439 also refers to the low yields of the known aqueous extraction process and to the difficulties of formulating adhesives from 100°C aqueous extracts. This specification provides also a method for producing a relatively low viscosity tannin extract involving separation and treatment of the high molecular weight material with one or more sulphite compounds to reduce the  
10 molecular weight prior to recombining with the low molecular weight material.

Neither of these methods teach a method or apparatus for increasing the extraction yield.

Australian Patent Specification 579,783 also recognises the difficulties which have been encountered with conventional extraction techniques. The difficulties which have been encountered are attributed primarily to excessive viscosity of the extracts and the difficulty in obtaining  
20 uniformity in product quality.

20 Specification 579,783 teaches a method for recovering tannin extract which comprises subjecting bark and/or wood to a first stage hot aqueous tannin extraction process, to obtain a first stage tannin extract. This is followed by a second stage hot aqueous extraction process at a higher pH than the first stage then recombining the first and second stage extracts. The specification further teaches the separation of high molecular weight material and treatment thereof with one or more sulphite compounds to reduce the  
30 molecular weight.

30 The use of a two stage process and the introduction of sulphites result in a more complex extraction method and increases the risk of environmental contamination.

In Australian Patent Specification 518,703 the point is made that although it is a relatively simple matter to prepare aqueous phenolic extracts from bark in the laboratory the phenolic materials contained in the extracts are very reactive and considerable difficulty is experienced in

preventing or minimising premature reactions which make the extracts obtained less useful. This specification refers to a hot water extraction process as not favoured for use with most bark species principally on account of the uneconomically low yields of extractives obtained.

Specification 518,703 teaches a method of treating an aqueous phenolic bark extract which involves adjusting the pH above 7 maintaining the extract temperature above 49°C for a period of up to 90 minutes and adjusting the pH of the extract to below pH 7. This method requires close monitoring of the extract and addition of chemicals to adjust pH. Moreover, the treatment method proposed is independent of the particular method used to derive the extract from the bark and accordingly does not provide increased extraction yields.

Accordingly a need exists for a novel method and apparatus for the more efficient extraction of tannins from bark.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to provide, in one embodiment, a novel method for extracting tannins from bark.

It is a further object of the present invention to provide, in another embodiment, a novel apparatus for extracting tannins from bark.

The present invention provides in one embodiment a method for extracting tannins from bark including the steps of:

contacting bark containing tannins with a first tannin enriched aqueous wash medium at elevated temperatures;

separating the tannin-rich liquid extract by filtration including dewatering the resulting filter cake under pressure;

washing the filter cake with a plurality of aqueous wash media at elevated temperatures; and

separating the tannin enriched media after each washing stage by filtration including dewatering the filter cake under pressure;

wherein each successive wash medium has a lower tannin content than the preceding wash medium.

According to a further embodiment the invention also provides a multi-stage apparatus for extracting tannin from bark comprising an extraction tank for slurring fresh bark with a tannin enriched wash medium to effect primary extraction;

a filter for filtering the slurry after primary extraction and for dewatering the resulting filter cake under pressure;

at least one wash liquor holding tank for providing a tannin enriched liquor for washing a filter cake in the filter;

a source of hot water for providing a final medium for washing the filter cake in the filter; and

pumping means for moving the slurry and/or liquid media between the tanks and the filter

wherein the filter is adapted for dewatering the filter cake under pressure between each separation and/or wash step.

The invention may also include a tannin rich recycle circuit. In this arrangement the tannin rich stream flowing from the filter may be separated whereby a portion thereof is recycled preferably via a holding tank or header tank to facilitate forming a pumpable slurry with fresh bark and whereby the remainder thereof is recovered from the system as a tannin rich extract. The removed portion may optionally undergo concentration whereby to form a concentrated extract.

The bark provided as a raw material for use according to the invention is preferably comminuted before introduction into the extraction tank. The introduced bark may be milled bark and is preferably finely milled so as to facilitate solid liquid contact and thereby improve the extraction rate. As higher molecular weight tannins do not readily diffuse it is preferable if only a smaller percentage, preferably not more than 5% of the bark is greater than 1 mm in size. In a typical run of mill bark sample at least 20% of the sample may be less than 125 microns.

A typical distribution for run of mill pinus radiata bark suitable for use in accordance with the present invention is as follows:

Less than 125 microns	43%
More than 125 microns	19.5%
More than 212 microns	16.9%
More than 355 microns	13.6%
More than 600 microns	3.9%
More than 1 mm	0.5%

Although the present invention is particularly suitable for application to pinus radiata bark it is to be appreciated that the invention may also be applied to other barks and to other tannin containing wood products.

The filter provided in accordance with the invention is preferably a pressure filter of the plate and frame type. Preferably the filter incorporates the means for dewatering the filter cake under pressure. It is to be appreciated that the filtration and the dewatering may occur simultaneously. In some cases a degree of filtering may occur as the slurry is pumped into the filter and further dewatering may occur after the increased pressure is applied.

It is important for efficient operation of the invention that the dewatering of the filter cake after separation of each liquid extract is as complete as possible. Although tannins dissolve fairly readily in hot water it has been found that moist bark such as the bark residue after filtration can retain more than 100% or even 150% and typically around 200% of moisture by weight of dry bark. If such moisture is not minimised a considerable amount of dissolved tannin will not be separated into the liquid extracts. It is particularly preferred for dewatering to reduce the moisture content of the filter cake to less than 100% or if possible 50% by weight of dry bark.

It has been found particularly preferable if the filter applies a pressure of at least 10 bar and preferably a pressure in the range of 12 to 16 bar to the filter cake during dewatering.

A fully automatic pressure filter is preferred for use in accordance with the present invention and it has been found that a filter with a diaphragm pressing system is

particularly suitable for use in the present invention. One such filter which we have found particularly suitable is the Larox pressur filter.

The primary extraction of tannins from comminuted bark may be conducted in an extraction tank. The bark and wash liquor may be slurried in the extraction tank at elevated temperatures. Preferably the tannin enriched wash medium is at a temperature of at least 60°C and most preferably between 90° and 100°C when brought into contact with the bark.

10 The present invention operates on a counter current multi-stage washing sequence wherein each successive wash medium has a lower tannin content than the preceding wash medium. The final wash medium is preferably water having no tannin enrichment.

It has been found convenient if each wash medium is stored in a holding tank at elevated temperatures preferably above 60°C and most preferably between 90° and 100°C between each wash cycle. Accordingly it is preferred if each holding tank has heating means and/or insulation associated therewith.

20 It has been found that the method provided by the present invention gives improved results if the milled bark and enriched wash liquor are slurried in the extraction tank at elevated temperatures for an ageing period prior to initial separation in the filter. An ageing period of between 10 minutes and 1 hour, preferably between 15 minutes and 45 minutes and most preferably between 20 minutes and 40 minutes has been found effective in increasing the rate of extraction of tannins in accordance with the invention.

30 To avoid the filter lying idle during the ageing period a second extraction tank may be provided in accordance with the invention whereby the slurried bark and wash liquor in the second tank may undergo ageing while the contents of the first tank is undergoing separation and washing and vice versa.

The apparatus provided in accordance with the present invention may also include agitating means for maintaining the slurry in suspension in the extraction tank. Preferably the



apparatus also includes insulation means for retaining liquids in the system at elevated temperatures.

As tannins tend to chelate with the iron in mild steel causing darkening of the colour of the extract and blackening of the equipment it is preferred if the apparatus of the invention is constructed from stainless steel, plastics or other inert materials.

10 The source of hot water may be a holding tank adapted to be refilled with water as required and preferably adapted for heating water to the desired elevated temperature.

Preferably the bark undergoes a plurality of washing stages following initial separation of the slurry. There may be at least 2 preferably 3 and most preferably between 2 and 4 and not more than 5 washing stages following initial separation of the slurry. The wash medium used in each stage has a lower tannin content than that of the preceding stage. The final wash medium may be unenriched water.

20 For use in particle board manufacture a solids content of at least 30% tannin and preferably from 35 to 45% is preferred in the final extract. The tannin rich extract from the filter may accordingly be passed through an evaporator to form a concentrated extract of the desired concentration. Conventional evaporators such as falling film, forced circular or plate evaporators are suitable for use in accordance with the invention.

30 The extraction method and apparatus provided according to the invention has been found to be efficient and adaptable in that by varying the amount of wash liquor employed the tannin concentration in the final extract may vary. For example if the volume of wash liquor is increased the volume of extract will increase but the concentration will reduce.

The spent bark after undergoing tannin extraction in accordance with the invention may be used as fuel or for horticultural or other applications.

A preferred embodiment of the invention will now be described in relation to the drawing.

#### BRIEF DESCRIPTION OF THE DRAWING

Figure 1 comprises a schematic representation of a tannin extraction apparatus in accordance with the present invention.

#### DETAILED DESCRIPTION

Fresh wash hot water is introduced into the apparatus via holding tank 1. Faucet means is provided for topping up tank 1 with fresh water. Tank 1 is also provided with heating means to facilitate water being drawn from tank 1 at elevated temperatures preferably between 95 and 100°C.

10 Extraction of tannin according to the present invention is achieved by successive washing with progressively more dilute solutions at elevated temperatures with filtration and dewatering between each washing stage until the strength of the enriched solutions decreases below a predetermined level. The hot water from tank 1 comprises the final wash solution.

Holding tanks 2 to 5 progressively hold tannin enriched liquors of increasing concentration. Each tank may be insulated and/or may contain heating means to facilitate wash media being drawn from the tank at an elevated temperature preferably in the range of from 95 to 100°C.

20 Tank 6 comprises an extraction tank for slurrying fresh comminuted bark with the wash liquor from tank 5 which is a tannin enriched wash medium.

In the operation of the apparatus shown in Figure 1 according to the method provided by the present invention finely comminuted bark a majority of which is preferably ~~1mm~~ in size, is added to extraction tank 6. An extraction solution being tannin enriched wash liquors from tanks 4 and 5 is added to tank 6. After the bark and extraction solution is aged in tank 6 under agitation at elevated temperature for a period of not more than 1 hour and preferably for a period of from 20 to 40 minutes, the slurry is pumped to the pressure filter in which the final rich liquor is separated from the bark. The final rich liquor which may contain approximately 10 to 15% tannin depending upon the amount of wash water introduced per cycle is divided into two streams. One stream is passed via paths 9 and 6 to rich recycle liquor

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tank 5. This stream forms a rich liquor recycle circuit within the apparatus of the invention. The other stream which may comprise the balance of the rich liquor extract from the pressure filter passes through rich extract holding tank 7 via paths 10 and 11 to be concentrated in the evaporator. The concentrated extract from the evaporator may have a tannin solids content of at least 30% and preferably around 40%. The extract is passed to holding tank 8 via path 12. The removed moisture may pass through a condensor via path 13 before discharge from the system.

The filter cake remaining in the pressure filter is washed by a wash liquor from tank 4 which in a typical example may increase from approximately 2-3% tannin as it proceeds via path 4 to the filter to approximately 12% tannin as it proceeds via path 6 to holding tank 5 and subsequently extraction tank 6.

Holding tank 5 acts as a header tank for enriched wash liquor and is used for withholding the wash liquor while wash liquor from a preceding cycle is ageing with bark in tank 6 and being fed into the filter. Holding tank 5 accordingly forms part of a rich liquor recycle circuit.

It is to be appreciated that the rich recycle liquor in tank 5 and rich extract in tank 7 have the same tannin content as tanks 5 and 7 are filled by a separation of the tannin rich stream flowing from the filter via path 9. The internal rich liquor recycle so formed increases the amount of liquid in tank 6 preferably to a level of 5 parts liquid to 1 part bark which facilitates forming a pumpable slurry with the bark.

Tank 5 accordingly acts as a holding tank for that proportion of the filter extract to be recycled. It is preferred to use a holding tank rather than to introduce the recycle stream directly into tank 6 as the extract to be recycled in any particular cycle may commence flowing from the filter along paths 9 and 6 before tank 6 is emptied of slurry.

After separation of the liquid phase from tank 6 in the

pressure filter to provide the filter cake, the cake may be washed successively by the wash liquors in tanks 4, 3, 2 and 1 via paths 4, 3, 2 and 1 respectively.

In a typical arrangement the wash liquors held in tanks 4, 3 and 2 may respectively hold approximately 2-3, 1 and 0.5% tannin.

10 Although not shown in Figure 1 a second extraction tank may be provided to enable ageing of a bark and concentrated wash liquor slurry in one tank while material from the other extraction tank is undergoing multi-stage washing. The second extraction tank may be filled with enriched wash media from the pressure filter via an alternative path 7 and from wash liquor tank 5 via an alternative path 6.

Fresh bark is added to the system via path 20 to extraction tank 6.

By finely milling or otherwise comminuting the bark prior to addition to extraction tank 6 via path 20 the tannin extraction is facilitated and a pumpable slurry is formed.

20 It may be necessary to pre-dry the bark to restrain tannin polymerisation through a composting action which may occur if the bark is left in large moist stockpiles. Similarly, if the bark is not pre-dried prior to addition to the system excessive moisture which may be up to 120% or more by weight would effectively dilute the rich extract proceeding via path 10 to tank 7 and thereby reduce the effectiveness of the invention.

30 If drying is required prior to addition of fresh bark via path 20 a simple hot air dryer would be suitable. Such a dryer may be fired at least partly by spent bark removed from the system via path 8.

Preferably each of tanks 1 to 6 is insulated and/or heated and all pipes are preferably lagged whereby to maintain all liquids upstream of rich extract tank 7 at elevated temperatures.

Older butt log bark has a higher tannin content than younger strand bark however the younger bark generally contains tannins of a lower molecular weight and is therefore

easier to extract.

10 The nature of the bark accordingly determines the molecular weight of the tannins produced in accordance with the invention. One of the advantages provided by the present invention is that the extraction of naturally occurring tannins from bark may be carried out without the addition of any reagents other than water. However, additives may be introduced into the system for example if the molecular weight characteristics of the final product are to be altered. Additives may be added to extraction tank 6 when fresh bark is introduced or may be added elsewhere into the system.

A small amount of phenol, preferably not more than 5% and most preferably around 3% on tannin solids may be added to the pre-concentrate to reduce concentrate viscosity. Such an additive addition may retard mold growth in the concentrated extract which may otherwise be encouraged by the presence of sugars, gums, etc. in the extract.

20 The spent bark after the final washing and dewatering stage may be removed from the filter via path 8 and may be used for nursery and horticultural applications. The spent bark may also be a suitable fuel for example to provide hot gases for drying fresh bark thereby conserving energy within the system.

30 The method and apparatus provided by the present invention provides a mechanical extraction method which avoids degrading the tannin molecules by chemical attack and also provides for high tannin extraction efficiencies without using large quantities of liquid. The low water/dry bark ratio preferably in the vicinity of 3:1 results in a high concentration extract preferably in the region of 10 to 15%. The use of a water/dry bark ratio in the region of 3.5:1 would generally not be sufficient to form a pumpable slurry suitable for extraction however by recycling a portion of the rich extract this can be achieved in accordance with the present invention. The present invention accordingly facilitates the production of a high concentration tannin

extract without the need for extensive evaporation. Further, by using only hot water for the extraction no potentially injurious chemical salts are introduced.

Bark can be rather bulky and difficult to transport. The present invention has the added advantage that movement of bark is kept to a minimum.

10 While it has been convenient to describe the invention herein in relation to particularly preferred embodiments, it is to be appreciated that other constructions and arrangements are also considered as falling within the scope of the invention. Various modifications, alterations, variations and/or additions to the constructions and arrangements described herein are also considered as falling within the scope and ambit of the present invention.

CLAIMS

1. A method for extracting tannins from bark including the steps of:
  - contacting bark containing tannins with a first tannin enriched aqueous wash medium at elevated temperatures;
  - separating the tannin-rich liquid extract by filtration including dewatering the resulting filter cake under pressure;
  - 10 washing the filter cake with a plurality of aqueous wash media at elevated temperatures; and
  - separating the tannin enriched media after each washing stage by filtration including dewatering the filter cake under pressure;
  - wherein each successive wash medium has a lower degree of tannin enrichment than the preceding wash medium.
2. A method according to claim 1 in which the final wash medium comprises water.
3. A method according to claim 1 or claim 2 in which th  
20 first tannin enriched aqueous wash medium used to contact the bark contains a proportion of the tannin-rich liquid extract.
4. A method according to any preceding claim in which the tannin-rich liquid extract is subjected to concentration whereby to form a concentrated extract.
5. A method according to any preceding claim in which the bark comprises pinus radiata bark.
6. A method according to any preceding claim in which the bark is comminuted before introduction into the extraction tank.
- 30 7. A method according to claim 6 in which not more than 5% of the bark is greater than 1 mm in any dimension.
8. A method according to any preceding claim in which a pressure of at least 10 bar is applied to the filter cak during each dewatering operation.
9. A method according to any preceding claim in which the first tannin enriched aqueous wash medium is at a temperatur f between 90° and 100°C when brought into

contact with the bark.

10. A method according to claim 9 in which each tannin enriched aqueous wash medium is held at a temperature of between 90° and 100°C between each wash cycle.

11. A method according to any preceding claim in which the bark and the first tannin enriched wash medium are slurried at elevated temperatures for an ageing period of between 10 minutes and 1 hour.

12. A method according to any preceding claim which includes between 2 and 4 washing stages following the initial separation of the bark from the first tannin enriched aqueous wash medium.

13. A method according to claim 12 in which the separation of the tannin-rich liquid extract, each washing stage and each subsequent dewatering stage occur within the filter without displacement of the filter cake from the filter.

14. Apparatus for extracting tannins from bark containing tannins, and comprising:

20 extraction tank for slurrying fresh bark with a tannin enriched wash medium to effect primary extraction;

a filter for filtering the slurry after primary extraction and for dewatering the resulting filter cake under pressure;

at least one wash liquor holding tank for providing a tannin enriched liquor for washing the filter cake in the filter;

a source of hot water for providing a final medium for washing the filter cake in the filter; and

30 pumping means for moving the slurry and/or liquid media between the tanks and the filter

wherein the filter is adapted for dewatering the filter cake under pressure between each separation and/or wash step.

15. Apparatus according to claim 14 which further includes agitating means for retaining the slurry in suspension in the extraction tank.



16. Apparatus according to claim 14 or claim 15 which further includes a tannin-rich recycle circuit whereby to separate the tannin-rich stream flowing from the filter following the primary extraction and recycle a portion of said stream to said extraction tank.

17. Apparatus according to any one of claims 14 to 16 in which the filter is adapted to apply a pressure of at least 10 bar to the filter cake during dewatering.

10 18. Apparatus according to any one of claims 14 to 17 in which a second extraction tank is provided whereby the contents of the second tank may undergo ageing while the contents of the first extraction tank undergo separation and washing.

19. Apparatus according to any one of claims 14 to 18 and including at least 3 wash liquor holding tanks for providing wash media of successively lower tannin contents.

20. Apparatus according to any one of claims 14 to 19 and further including an evaporator adapted to form a concentrated extract from the tannin-rich liquid extract.

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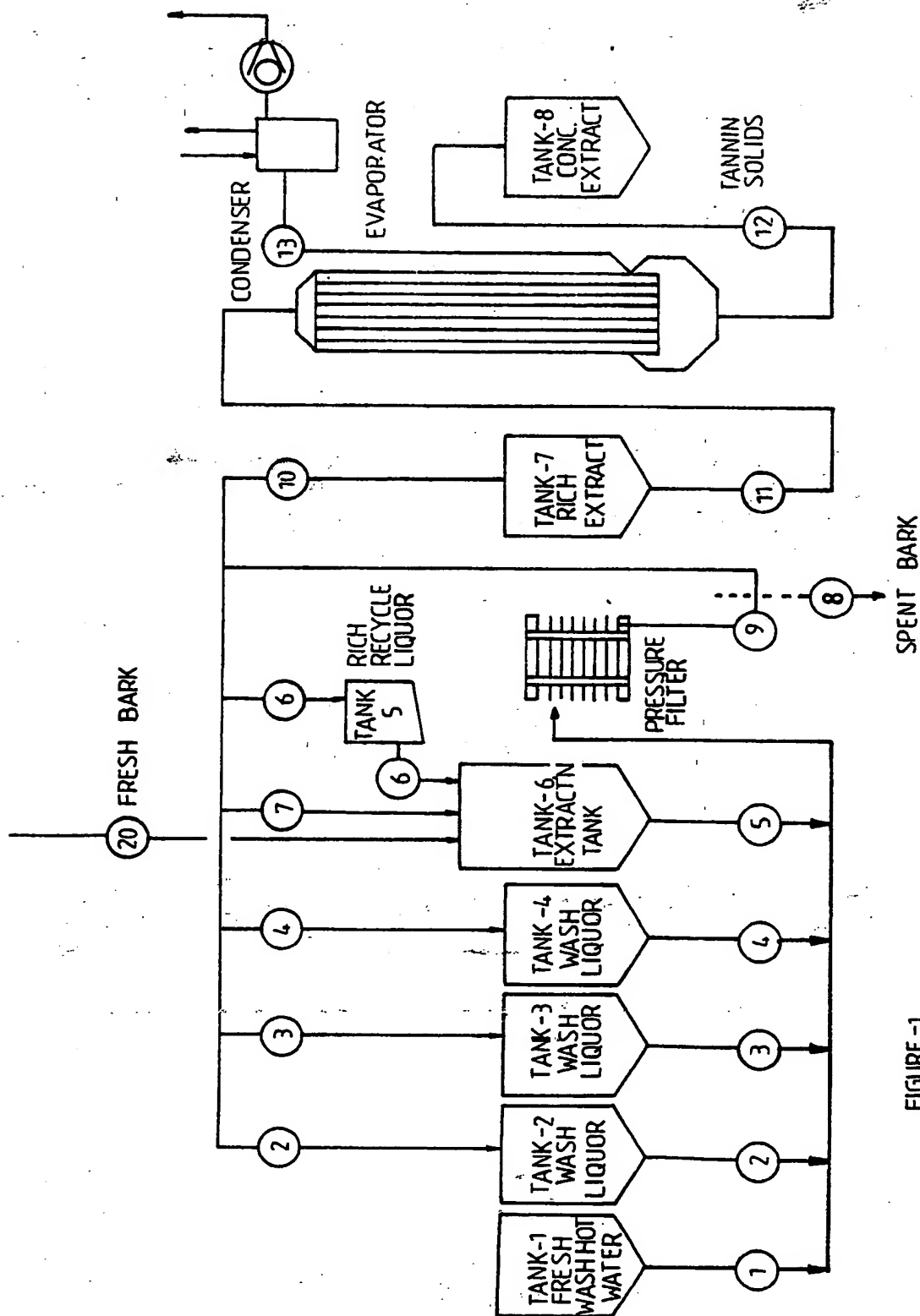


FIGURE -1

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.<sup>5</sup> C07G 017/00

## II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System | Classification Symbols

IPC

C07G 017/00

Documentation Searched other than Minimum Documentation  
to the extent that such Documents are Included in the Fields Searched 8


AU : IPC as above

DATA BASES : FOREST PRODUCTS; WPAT; KEYWORD: TANNIN

## III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
A	AU,B, 66928/86 (569439) (C.S.I.R.O.) 25 July 1987 (25.07.87)	(1-20)
A	AU,B, 81663/87 (579783) (C.S.I.R.O.) 17 March 1988 (17.03.88)	(1-20)
A	GB,A, 2174386 (AFRICAN TERRITORIES WATTLE INDUSTRY FUND LIMITED UK) 5 November 1986 (05.11.86)	(1-20)
A	Holz als Roh- und Werkstoff, Volume 44, issued 1986, Tisler V. et al. "Fractionation of hot water extract from Picea abies Karst. bark", see pages 427-431	(1-20)
A	Chemical Abstracts, Vol 108, no. 24 issued 1988 (Columbus, Ohio, U.S.A.) Rahman, M.D. et al.; "Interactions of starch and other polysaccharides with condensed tannins in hot water extracts of ponderosa pine bark", see page 106 column 1, the abstract no. 206528k; and J. Wood Chem. Technol. 1988, 8(1), 111-20 (Eng)	(1-20)
<p>* Special categories of cited documents: 10</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Z" document member of the same patent family</p>		

## IV. CERTIFICATION

Date of the Actual Completion of the International Search 12 November 1990 (12.11.90)	Date of Mailing of this International Search Report 23 November 1990
International Searching Authority Australian Patent Office	Signature of Authorized Officer  A.W. BESTOW

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	Chemical Abstracts, Vol 97, no. 20 issued 1982 (Columbus, Ohio, U.S.A.) Manas, A.E.; "Tannin extraction and utilisation from Bakauian barks: see page 99 column 1, the abstract no. 164739b and NSTA Technol. J. 1982, 7(1), 57-64 (Eng)	(1-20)
A	Chemical Abstracts, Vol 102, no. 2 issued 1985 (Columbus, Ohio, U.S.A.) Dix, B et al.; "Tannin extracts from spruce and pine barks", see page 97 column 1, the abstract no. 8404e and J. Appl. Polym. Sci.: Appl. Polym. Symp. 1984 40 (Wood Adhesives), 91-100 (Eng)	(1-20)

## V. [ ] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:
2. [ ] Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. [ ] Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4 (a):

## VI. [ ] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING 2

This International Searching Authority found multiple inventions in this international application as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- [ ] The additional search fees were accompanied by applicant's protest.  
 [ ] No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON  
INTERNATIONAL APPLICATION NO. PCT/AU 90/00335

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Patent Document  
Cited in Search  
Report

Patent Family Members

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AU 66928/86

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AU 81663/87

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GB 2174386

ZA 8603095

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END OF ANNEX